



U.S. Department
of Transportation

**Federal Aviation
Administration**

Memorandum

Subject: ACTION: Review and Concurrence, Equivalent Level of Safety; ACE-03-01

Date: November 28, 2003

From: Manager, Regulations and Policy, ACE-111

Reply to Peter L. Rouse
Attn. of: 816-329-4135

To: Manager, Small Airplane Directorate, ACE-100

The Small Airplane Directorate is processing an application for an Amended Type Certificate for the Diamond DA 40 long-range fuel tank. The purpose of this memorandum is to request your concurrence regarding an equivalent level of safety finding for an auxiliary fuel level indication system. The auxiliary fuel level indication system does not directly comply with 14 CFR, part 23, § 23.1337(b). The primary concerns are the auxiliary fuel level indication system accuracy and its effect on aircraft weight and balance, lateral fuel imbalance, and aircraft range.

Background:

The Diamond Model DA-40 aircraft is a composite, conventional single-engine tractor configuration airplane, certificated in the Normal Category. The wing is unswept, and high lift devices are employed to obtain a high lift-to-drag ratio during takeoff and landing.

Applicable Regulations:

14 CFR, part 23, § 23.1337(b): Fuel quantity indicator states:

There must be a means to indicate to the flightcrew members the quantity of usable fuel in each tank during flight. An indicator calibrated in appropriate units and clearly marked to indicate those units must be used. In addition--

- (1) Each fuel quantity indicator must be calibrated to read "zero" during level flight when the quantity of fuel remaining in the tank is equal to the unusable fuel supply determined under [Sec. 23.959(a);]*
- (2) Each exposed sight gauge used as a fuel quantity indicator must be protected against damage;*
- (3) Each sight gauge that forms a trap in which water can collect and freeze must have means to allow drainage on the ground;*
- (4) There must be a means to indicate the amount of usable fuel in each tank when the airplane is on the ground (such as by a stick gauge);*
- (5) Tanks with interconnected outlets and air spaces may be considered as one tank and need not have separate indicators; and*
- (6) No fuel quantity indicator is required for an auxiliary tank that is used only to transfer fuel to other tanks if the relative size of the tank, the rate of fuel transfer, and operating instructions are adequate to—*
 - i. Guard against overflow; and*

- ii. *Give the flight crewmembers prompt warning if transfer is not proceeding as planned.*

The proposed long-range tank system, as described, does not directly comply with 14 CFR, part 23, § 23.1337(b) because of how the available fuel quantity is measured during flight. The rule requires there be a means available to indicate to the crew the quantity of usable fuel in each tank during flight. It is assumed that this means is accurate. If the flight crewmember sets the AUX FUEL QTY switch to the left or right position and the fuel quantity is below three gallons, the center quantity indicator will read "zero." Additionally, there is a CAUTION that states, "After selecting a fuel tank, the fuel quantity indication will be incorrect for two minutes." We believe the auxiliary fuel level indication system is reliable but is not fully accurate.

Compensating Features:

The Airplane Flight Manual, AFM, does give guidance to the flightcrew on how to deal with the auxiliary fuel measurement band of uncertainty. The fuel indication uncertainty does not change the amount of unusable fuel; therefore, there is no reason to change that number. The AFM verbiage gives an equivalent level of safety against the requirements of § 23.1337(b).

1. The AFM will include the following statements concerning the aircraft weight and balance limitations:

6.4 FLIGHT MASS AND CENTER OF GRAVITY

The first paragraph of step 2 of the procedure is amended as follows:

2. Read the fuel quantity indicators to determine the fuel quantity.

NOTE

When the fuel quantity indicator reads 16 US gal, read the auxiliary fuel quantity by setting the AUX FUEL QTY switch to the appropriate position (LH or RH), and add the auxiliary fuel quantity to the 16 US gal.

NOTE

An auxiliary fuel quantity below 3 US gal cannot be indicated by the system. For auxiliary fuel quantities below 3 US gal, the correct fuel quantity must be determined with the fuel quantity measuring device (see Section 7.10 FUEL SYSTEM).

2. The AFM will include the following statements concerning the lateral imbalance limitation:

Fuel Quantity: Total fuel quantity	: 2 x 24.5 US gal (approx. 185 liters)
Unusable fuel	: 2 x 0.5 US gal (approx. 3.8 liters)
Max. indicated fuel quantity	: 16 US gal per tank
Indicated auxiliary fuel quantity	: 3 to 9 US gal per tank
Max. permissible difference between right and left tank	: 8 US gal (approx. 30.3 liters)

CAUTION

If a fuel indicator shows 16 US gal and the aux. fuel indicator 0 US gal for the same fuel tank, then 19 US gal must be assumed for the calculation of the difference between right and left tank.

3. The AFM will include the following statements concerning the impact on aircraft range:

5.3.2 TABLE FOR SETTING ENGINE PERFORMANCE

NOTE

An auxiliary fuel below 3 US gal cannot be indicated by the system. If a fuel indicator shows 16 US gal and the auxiliary fuel indicator 0 US gal for the same fuel tank, for in-flight fuel consumption/flight planning a fuel quantity available of 16 US gal must be assumed.

4. A limitation placard next to the fuel quantity indication shall state the following:

Fuel qty. indication: 16 + 9 US gal
max. difference LH/RH tank: 8 US gal
AUX FUEL QTY switch for LH/RH auxiliary fuel quantity
NOTE: See AFM For More Information On AUX FUEL

Recommendation:

We concur that the Airplane Flight Manual, AFM, does give guidance to the flightcrew on how to deal with the auxiliary fuel measurement band of uncertainty and that the guidance provides an equivalent level of safety as envisioned in the regulations and, therefore, meets the requirements of 14 CFR, part 23, § 23.1337(b).

s/ Patrick Mullen for

Scott L. Sedgwick

Concurred by:

s/ David Showers

Manager, Standards Staff, ACE-110

11/28/03
Date

s/ Michael Gallagher

Manager, Small Airplane Directorate
Aircraft Certification Service, ACE-100

11/28/03
Date